

REMARKS

This application was originally filed with 29 claims. Original Claims 22, 24, and 25 were renumbered as Claims 27-29. Claims 1-26 were previously canceled and Claims 27-55 were previously added by Preliminary Amendment. Original Claims 27-38, 44, 48, 50, 52-55, 57 and 58 (as renumbered) have been canceled in this Response and Amendment. Claims 27-55 have been renumbered as Claims 30-58. Therefore, Claims 39-43, 45-47, 49, 51, 56, and 59-61 are pending in this Application.

Claims 27-58 have been rejected. Claims 39-43, 45-47, 49, 51, and 56 have been amended. Reconsideration of the application based on the remaining claims as amended and arguments submitted below is respectfully requested.

Objections to the Specification

The disclosure has been objected to because the specification did not include a brief description of Figures 11-14. In response, Applicant has amended the specification to include such descriptions.

Objections to the Drawings

The drawings have been objected to for not showing every feature of the invention as specified in the claims. In particular, the objection states that the following claim terms are not shown in the drawings: electrical power supply, cone tip, pyramid tip, hydrogen tip, dopant tip, annular gate, and grid gate.

Respectfully, Applicant does not understand the entirety of this objection. Accordingly, each term cited by the Office Action will be addressed separately.

“Electrical power supply”: This precise phrase is not used in the claims. Some of the claims (Claim 56 for example) make reference to a “biasing energy supply”. Such a biasing supply is shown in the drawings as power supply 1114 on Fig. 11, and power supply 1218 on Fig. 12. If the reference to “electrical power supply” is to the claim in its entirety (as in Claim 56), the device of Claim 56 is illustrated in Figures 11-14.

“Cone tip”: The term “cone” is not used in the claims. The term “conical tip” is used in the claims. This feature is shown in Fig. 14 (tip 1402), as explained at page 19, lines 28-29, of the specification.

“Pyramid tip”: A pyramidal tip is shown in Fig. 14 (tip 1402), as explained at page 19, lines 28-29, of the specification. Applicant respectfully submits that tip 1402 as shown in Fig. 14 is capable of representing both conical and pyramidal shapes, as explained in the specification.

“Hydrogen tip”: Claim 35 references “hydrogen tip termination.” This feature is described in the specification at page 6, line 28 through page 7, line 5. Applicant respectfully submits that the hydrogen termination of a diamond cathode tip is a chemical enhancement feature, not a distinct structural feature that requires illustration in the drawings.

“Dopant tip”: The phrase “dopant tip” is not used in the claims. Claim 37 references a “dopant.” Applicant respectfully submits that the use of a dopant in a

semiconductor material as described in the specification and as used in the claims is an internal chemical feature, not a distinct structural feature that requires illustration in the drawings. Also, Claim 37 has been canceled.

“Annular gate”: An annular gate structure is shown in Fig. 4, as described in the specification at page 5, lines 1-2 and on page 11, lines 16-18 (as amended herein).

“Grid gate”: The phrase “grid gate” is not used in the claims. A device gate structure having multiple gate electrodes 1404 forming a grid is shown in Fig. 14.

The drawings were also objected to on the basis that they failed to show a heat source connected to the cathode. Such a heat source is shown schematically connected to the cathode in Fig. 6. A heat source is also shown connected to the cathode in Fig. 8. In the application and claims, the term “connected” should be construed to include a thermal connection as well as a physical connection.

Based on the foregoing explanations, Applicant respectfully submits that the objections to the drawings should be withdrawn.

Objections to the Claims

The application as filed contained 29 total claims, three of which were misnumbered. The claims were objected to due to an improper numbering of the claims. A Preliminary Amendment canceling original Claims 1-26 and adding Claims 27-55 was filed with the Transmittal Letter on March 15, 2002. The Examiner has renumbered original Claims 22, 24, and 25 as Claims 27-29 and has renumbered Claims 27-55 as Claims 30-58. Applicant has canceled Claims 27-29 in

this Response and Amendment. Applicant accepts the renumbering of the remaining Claims 30-58 as stated by the Examiner and as identified in the Listing of Claims provided in this Response and Amendment.

Claims 27-29 have been objected to under 37 C.F.R. § 1.75 as being a substantial duplication of Claims 57-58. In this Response and Amendment, Applicant has canceled Claims 27-29, rendering this objection moot.

Claim Rejections - 35 U.S.C. § 102(b)

Claims 29-32, 37-40, 45-48, 50-55, 57, and 58 are rejected under 35 U.S.C. § 102(b) as being anticipated by Geis, et al. (US 5,713,775). Claims 29-32, 37, 38, 48, 50, 57, and 58 have been cancelled, rendering the rejection of those claims moot.

Geis discloses a diamond cold cathode emitter that is substitutionally doped with nitrogen. In particular, Geis discloses a “rough” back contact for the diamond layer. According to Geis, the use of substitutional doping with nitrogen can enhance the injection of electrons from a conductor (such as a metal substrate) into a diamond cathode. (See col. 5, lines 43-51) Although, Geis makes reference to a “downward band bending” at col. 6, lines 44-48, Geis says nothing about using an enhancement means in the emitter structure to cause a preferential emission of higher energy electrons from the cathode to the anode. As explained in Applicant’s specification, by causing the diamond emitter to preferentially emit higher energy electrons, the average energy level of the replacement electrons in the cathode is lower. When the device is connected to a source of electrical energy and when the cathode is thermally connected to a heat source, a net transfer of thermal energy

results, causing a cooling of the heat source. These structural and functional limitations are part of Claim 39 as amended. Geis says nothing about the use of a diamond emitter structure as an electronic cooling device or as a device for transferring heat from a thermal energy source. Geis says nothing about providing a means to implement such a device. Therefore, Claim 39, as amended, and dependent Claim 40, are not anticipated by Geis.

With respect to Claim 45, as amended, Geis does not disclose bending the conduction band of the cathode to increase preferential field emission of higher energy electrons, thereby to cause an enhanced transfer of thermal energy from the cathode. Although, as noted by the Examiner, some transfer of thermal energy from the cathode to anode may be inherent in the operation of a generic electron emission device, efficient operation of a diamond emitter as an energy conversion device requires preferential emission of higher energy electrons. Geis simply does not address this important point. Accordingly, Claim 45, as amended, and dependent Claims 46, 47, and 51 are not anticipated by Geis.

Claims 30-35, 37, 38, 55, 56, 58, and 59 have been rejected under 35 U.S.C. 102(b) as being anticipated by von Windheim (US 5,679,895).

Von Windheim discloses an acceleration sensor using a diamond electron emitter. The emitter uses a raised tip to enhance field emission. The tip can also have a hydrogen terminated surface. With reference to Claim 56, as amended, von Windheim does not disclose a device having a cathode thermally connected to a thermal energy source. Von Windheim does not disclose a diamond cathode with an

emission enhancement means to cause a preferential emission of higher energy electrons. Von Windheim does not disclose a device wherein such a preferential emission occurs in response to transfer of thermal energy from the thermal energy source to the cathode, resulting in a corresponding transfer of electrical energy to an electrical load connected to the device. Therefore, Claim 56 is not anticipated by von Windheim. With respect to Claim 59, Applicant notes that it is a new claim submitted in this Response and Amendment and therefore its rejection in the Office Action is in error.

Claims 30-33 have been rejected under 35 U.S.C. 102(b) as being anticipated by Aragaki et al. (Aragaki) (JP 11-116555) (US 5,959,400). Claims 30-33 have been canceled, rendering this rejection moot.

Claim Rejections - 35 U.S.C. § 103

Claims 31-35 and 37 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Geis et al. (US 5,713,775) and von Windheim et al. (US 5,679,895). Claims 31-35 and 37 have been canceled, rendering this rejection moot.

Claims 31-34 and 41 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Geis et al. (US 5,713,775) and Kumar (US 5,399,238). With respect to Claim 41, and as discussed above, Geis does not teach the use of structural or chemical enhancement means in the emitter to cause a preferential emission of higher energy electrons so as to provide enhanced net transfer of thermal energy from the cathode to the anode. Kumar '238 teaches methods of forming low work function emission tips. Neither Geis nor Kumar specifically address the use of diamond

emitters in electronic cooling devices and of enhancing preferential emission of higher energy electrons for that purpose. Therefore, Claim 41, as amended, is patentable over Geis and Kumar '238.

Claims 36 and 49 have been rejected under 35 U.S.C. § 103(a) based on Geis, et al. (US 5,713,775) and Kumar et al (Kumar) (US 5,614,353). Claim 49, as amended, is dependent on Claim 45, which includes the step of bending the conduction band to increase preferential emission of higher energy electrons so as to cause an enhanced transfer of thermal energy. Kumar '353 disclosed methods of fabricating flat panel displays. Neither Geis nor Kumar '353 address the problem of enhanced thermal energy transfer using preferential emission of higher energy electrons. Therefore, Claim 49, as amended, is patentable over Geis and Kumar '353.

Claim 44 has been rejected under 35 U.S.C. § 103(a) based on Geis et al. (US 5,713,775) and Kumar (US 5,399,238). Claim 44 has been cancelled, rendering this rejection moot.

Claims 27-33, 35, 37-43, 52-58 have been rejected under 35 U.S.C. § 103(a) based on Haas (US 3,281,372) and Aragaki et al. (Aragaki) (JP 11-116555) (US 5,959,400). With respect to Claim 39, as amended, Haas describes a prior art thermionic energy conversion system but, as noted by the Examiner, does not disclose the application of a diamond emitter in such a system. Aragaki (a.k.a. Niigaki U.S. 5,959,400) describes an electron tube having a diamond emitter for use in displays. Thus, even if Haas and Aragaki could be combined, there is still no teaching of means incorporated in the emitter for causing a preferential transfer of higher energy

electrons. These means, of course, would be unique to the claimed diamond microtip emitter structure. Haas could not possibly supply such teaching and Aragaki simply doesn't address thermal energy transfer at all. Therefore, Claim 39, as amended, and dependent Claim 40 are patentable over Haas and Aragaki. Similarly, with respect to Claim 41, neither Haas nor Aragaki teach the use of structural or chemical enhancement means in the emitter to cause a preferential emission of higher energy electrons so as to provide enhanced net transfer of thermal energy from the cathode to the anode. Again, that teaching cannot be supplied by Haas because such means are unique to diamond emitters. Aragaki does not even address thermionic energy conversion at all. Therefore, Claim 41, as amended, and dependent Claims 42 and 43 are patentable over Haas and Aragaki. Claim 56, as amended, includes the limitation that the cathode includes means to cause preferential emission of higher energy electrons in response to transfer of thermal energy to the cathode. Aragaki does not even discuss this problem. Haas does not disclose such means, or even recognize the need for such means. Therefore, Claim 56, as amended, is patentable over Haas and Aragaki.

Claim 44 has been rejected under 35 U.S.C. 103(a) based on Haas (US 3,281,372) and Aragaki et al. (Aragaki) (JP 11-116555) (US 5,959,400). Claim 44 has been cancelled, rendering this rejection moot.

New Claims

New Claims 59-61 are dependent on Claim 56. As discussed above, Claim 56 as amended is patentable over the prior art of record. Therefore, Claims 59-61 should also be patentable.

Applicant has commented on some of the distinctions between the cited references and the claims to facilitate a better understanding of the present invention. This discussion is not exhaustive of the facets of the invention, and Applicant hereby reserves the right to present additional distinctions as appropriate. Furthermore, while these remarks may employ shortened, more specific, or variant descriptions of some of the claim language, Applicant respectfully notes that these remarks are not to be used to create implied limitations in the claims and only the actual wording of the claims should be considered against these references.

Pursuant to 37 C.F.R. § 1.136(a), Applicant petitions the Commissioner to extend the time for responding to the March 1, 2004, Office Action for 3 months from June 1, 2004, to September 1, 2004. Applicant encloses herewith a check in the amount of \$475 made payable to the Director of the USPTO for the petition fee. The Commissioner is authorized to charge any deficiency or credit any overpayment associated with the filing of this Response to Deposit Account 23-0035.



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Respectfully submitted,

Mark J. Patterson
Registration No. 30,412
WADDEY & PATTERSON
A Professional Corporation
Customer No. 23456

ATTORNEY FOR APPLICANT

CERTIFICATE OF FIRST CLASS MAILING

I hereby certify that this Response and Amendment, and a check in amount of \$475.00 are being deposited with the United States Postal Service as first class mail in an envelope addressed to:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

on September 1, 2004.

Mark J. Patterson

Signature
Registration Number 30,412

9/1/04

Date